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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/576,248	04/18/2006	Yuji Shinohara	127713	2140
25944 7590 07/21/2009 OLIFF & BERRIDGE, PLC P.O. BOX 320850 ALEXANDRIA, VA 22320-4850				
EXAMINER				
BOHATY, ANDREW K				
ART UNIT		PAPER NUMBER		
4132				
MAIL DATE		DELIVERY MODE		
07/21/2009		PAPER		

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

# Office Action Summary

**Application No.**

10/576,248

**Applicant(s)**

SHINOHARA ET AL.

**Examiner**

Andrew K. Bohaty

**Art Unit**

4132

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-32 is/are pending in the application.
- 4a) Of the above claim(s) 14, 15, 31 and 32 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-13 and 16-30 is/are rejected.
- 7) ☒ Claim(s) 5, 8 and 23 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 18 April 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date 2006/04/18, 2006/07/25, 2008/03/20, 2008/04/01, 2008/09/05
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date: \_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_



**DETAILED ACTION**

***Election/Restrictions***

1. Restriction is required under 35 U.S.C. 121 and 372.
2. This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.
3. In accordance with 37 CFR 1.499, applicant is required, in reply to this action, to elect a single invention to which the claims must be restricted.

Group I, claim(s) 1-13 and 16-30, drawn to a hole transport material.

Group II, claim(s) 14, 15, 31, and 32, drawn to a method of manufacturing a hole transport material.

4. The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

5. Groups I and II lack unity of invention because even though the inventions of these groups require the technical feature of a hole transporting material, when in a layer in an organic EL device, containing nonionic impurities, of a molecular weight of 5,000 or less, of 2,000 ppm or less, this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of Azuma et al. (WO 00/41443) where Higashi et al. (US 2004/0007971) (hereafter "Higashi") is used as the US equivalent. Higashi teaches a hole transporting material having nonionic impurities, having a molecular weight of 5,000 or less, of 1,000 ppm or less (abstract, Production example 2, preparation of hole transporting material, paragraphs [0146]-[0149]). Higashi teaches that the use of purified hole transporting material as a hole transporting layer in an organic EL device (paragraph [0167]).

6. During a telephone conversation with Azza Jayaprakash on 30 June 2009 a provisional election was made with traverse to prosecute the invention of Group I, claims 1-13 and 16-30. Affirmation of this election must be made by applicant in replying to this Office action. Claims 14, 15, 31, and 32 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

7. Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species or invention to be examined even though the requirement may be traversed (37 CFR 1.143) and (ii) identification of the claims encompassing the elected invention.

8. The election of an invention or species may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the restriction requirement, the election shall be treated as an election without traverse.

9. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

***Specification***

10. The disclosure is objected to because of the following informalities:

On page 3 last line, the word **hold** should be corrected to **hole**.

On page 5 the 3rd and 5th paragraphs, the phrase "described in claim 1" should be replaced in the written description of the material in claim 1. The definition of claim 1 can change due to amendment; therefore, the specification is unclear because the final definition of claim 1 is uncertain.

11. Appropriate correction is required.

***Claim Objections***

12. Claims 5, 8, and 23 are objected to because of the following informalities:

Regarding claims 5, 8, and 23 the word **hold** should be corrected to **hole**.

13. Appropriate correction is required.

14. Applicant is advised that should claim 12 be found allowable, claim 29 will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

***Claim Rejections - 35 USC § 102***

15. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

16. Claims 1, 2, 4, 9, 12, 13 and 29, are rejected under 35 U.S.C. 102(b) as being anticipated by Azuma et al. (WO 00/41443) where Higashi et al. (US 2004/0007971) (hereafter "Higashi") is used as the US equivalent.

17. Regarding claim 1, Higashi discloses a hole transport material (NPD, paragraph [0146]) to be used as a layer in the an EL device (paragraph [0169]), wherein the material when dissolved in a liquid to have a concentration of 2.0 wt% has nonionic impurities (paragraph [0148]) having a molecular weight of 5,000 or less at an amount of the nonionic impurities of 20 ppm or less (paragraphs [0148] and [0149]) (Although Higashi does not implicitly teach a dissolved material, Higashi does disclose a material having nonionic impurities having a molecular weight of 5,000 or less (paragraph [0148]) discloses the nonionic impurities to be 1-iodonaphthalene, approximate molecular weight 254, N-(naphthyl-1-yl)-N-N'-diphenyl-4,4'-benzidine, approximate molecular weight 262, and amine oxides, all amine oxides produced from the reaction would have a molecular weight less than 5,000 since all the amines in the reaction are much less

than 5,000 molecular weight and adding oxygen to any of the amines will not make the molecular weight exceed 5,000), at an amount of 1,000 ppm or less and if this material is dissolved at a concentration of 2.0 wt% the amount of nonionic impurities in the solution would be 20 ppm or less (when a material that contains nonionic impurities of 1,000 ppm or less and the material is dissolved in a solution to make a 2.0 wt% solution the amount of impurities that will be dissolved in the solution will be 20 ppm or less,  $1,000 \text{ ppm} \times 2.0 \% = 20$  ).

18. Regarding claim 2, Higashi discloses the nonionic impurities are those which are formed and/or mixed when synthesizing the hole transport material (paragraph [0148]).

19. Regarding claim 4, Higashi discloses the hole transport material is an arylamine-based compound (NPD, paragraph [0146]).

20. Regarding claims 9, 12, 13, and 29, Higashi discloses a hole transport layer (NPD, paragraph [0169]) in an organic EL device (abstract), wherein the major component of the layer is a the hole transport material that contains nonionic impurities having a molecular weight of 5,000 or less (paragraph [0148] discloses the nonionic impurities to be 1-iodonaphthalene, approximate molecular weight 254, N-(naphthyl-1-yl)-N'-N'-diphenyl-4,4'-benzidine, approximate molecular weight 262, and amine oxides, all amine oxides produced from the reaction would have a molecular weight less than 5,000 since all the amines in the reaction are much less than 5,000 molecular weight and adding oxygen to any of the amines will not make the molecular weight exceed 5,000), but the amount of the nonionic impurities is 1,000 ppm or less (NPD, paragraphs [0148] and [0149]). When a material that contains nonionic impurities of 1,000 ppm or

less and the material is dissolved in a solution to make a 2.0 wt% solution the amount of impurities that will be dissolved in the solution will be 20 ppm or less,  $1,000 \text{ ppm} \times 2.0\% = 20$ .

***Claim Rejections - 35 USC § 103***

21. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

22. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

23. Claims 1-13 and 16-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Enomoto et al (KR 2003/078731), where Naito et al. (US 2004/0018386) (hereafter "Naito") is a patent family member was will be used as the English translation.

24. Regarding claim 1, Naito discloses a hole transport material (paragraphs [0010] and [0100], PEDOT.PSS) having the function of transporting holes in an organic EL

device (paragraph [0010]) (Naito discloses the material as a hole injection layer, but the layer transport holes from the anode into the emission layer), wherein the material is dissolved in a solvent to make a 0.4 - 2.8 wt% solution (paragraph [0084]) and is purified using ultrafiltration with a membrane filter with a molecular weight cutoff between 8,000-25,000 to remove low molecular weight donor molecule ((poly(3,4-ethylenedioxythiophene) (paragraph [0033], which is a neutral impurity)) (paragraph [0081]) (This means molecular weights smaller than these value will be removed from the polymer during ultrafiltration). This means impurities having a molecular weight of 5,000 or less will be removed during the purification process.

25. Naito does not teach the amount of nonionic impurities present in the material.

26. Naito does teach that low molecular weight materials need to be removed from the material to prevent low molecular weight materials from acting as a trapping agent or quencher when used as a layer in an EL device (paragraph [0006]). Naito teaches that anions can be removed to a value of 2.5 ppm for a 2.0 wt% solution of the material (paragraph [0104], Table 1 C1, 1.0 ppm when the concentration is 0.8 wt% equal 2.5 ppm in a 2.0 wt% concentrated solution), Naito teaches removing the low molecular weight materials will enhance the emission efficiency and life of the EL device (paragraph [0006]).

27. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the hole transport material, of Naito, wherein in the hole transport material when dissolved to make a 2.0 wt% solution, the solution contains nonionic impurities having a molecular weight of 5,000 or less at amount of 40 ppm or

less. Naito shows that low molecular anions could be removed to as low as 2.5 ppm; therefore, showing impurities can be removed to be below 40 ppm. The motivation would be to remove the low molecular weight materials will enhance the emission efficiency and life of the EL device.

28. Regarding claims 2 and 3, Naito discloses that low molecular weight donor molecular, poly(3,4-ethylenedioxythiophene (paragraph [0033]), which is a neutral heterocyclic aromatic compound is a impurity that needs to be removed (paragraph [0081]).

29. Regarding claim 4, Naito discloses thiophene/styrenesulfonate-based compounds as the hole transport material (paragraph [0034]).

30. Regarding claim 5, Naito discloses a poly(thiophene/styrenesulfonate)-based compound as a major component (PEDOT.PSS, paragraphs [0100] and [0105]).

31. Naito does not teach the amount of nonionic impurities contained with respect to the number of styrene units.

32. Naito does teach that low molecular weight materials need to be removed from the material to prevent to low molecular weight materials from acting as a trapping agent or quencher when used as a layer in an EL device (paragraph [0006]). Naito teaches that anions can be removed to a value of 125 ppm in the layer (paragraph [0104]), which is a value lower than 6 impurities units per 1,000 styrene units. Naito teaches removing the low molecular weight materials will enhance the emission efficiency and life of the EL device (paragraph [0006]).

33. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the hole transport layer, of Naito, wherein in the hole transport materials contains an amount of nonionic impurities to be 6 with respect to 1,000 styrene units, when dissolved in a solvent to make a 2.0 wt% solution. The motivation would be to remove the low molecular weight materials will enhance the emission efficiency and life of the EL device.

34. Regarding claim 6, Naito does not disclose the use of NMR to measure the number of nonionic impurities to styrene, but since the modified hole transport material reads on claim 5, it does not make the characterization technique used to measure the amount of the impurity because the ratio is an inherent property of the purified material.

35. Regarding claim 7, Naito discloses the use of Baytron P VP CH8000 (paragraph [0100]) a poly(thiophene/styrenesulfonate)-based compound hole transport material and the material would be expected to have a thiophene to styrenesulfonate ratio of 1:20 (see Clevios P VP CH8000 information, under PEDT:PSS ratio, Baytron P VP CH8000 now goes by Clevios P VP CH8000).

36. Regarding claim 8, Naito discloses the use of Baytron P VP CH8000 (paragraph [0100]) as the hole transport material, which would be expected to have a volume resistivity of  $1 \times 10^5$  to  $3 \times 10^5 \Omega \cdot \text{cm}$  (see Clevios P VP CH8000 information, under resistivity, Baytron P VP CH8000 now goes by Clevios P VP CH8000).

37. Regarding claim 9, Naito discloses that the hole transport material (paragraphs [0010] and [0100], PEDOT:PSS) (Naito discloses the material as a hole injection layer, but the layer transport holes from the anode into the emission layer) can be used as the

major component to make a hole transport layer in and EL device (paragraphs [0010] and [0109]). Naito teaches the material used for the layer is purified using ultrafiltration with a membrane filter with a molecular weight cutoff between 8,000-25,000 to remove low molecular weight donor molecule ((poly(3,4-ethylenedioxythiophene) (paragraph [0033], which is a neutral impurity)) (paragraph [0081]) (This means molecular weights smaller than these value will be removed from the polymer during ultrafiltration). This means impurities having a molecular weight of 5,000 or less will be removed during the purification process.

38. Naito does not teach the amount of nonionic impurities present in the layer.

39. Naito does teach that low molecular weight materials need to be removed from the material to prevent low molecular weight materials from acting as a trapping agent or quencher when used as a layer in an EL device (paragraph [0006]). Naito teaches that anions can be removed to a value of 125 ppm in the layer (paragraph [0104]). Naito teaches removing the low molecular weight materials will enhance the emission efficiency and life of the EL device (paragraph [0006]).

40. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the hole transport layer, of Naito, wherein the hole transport layer contains nonionic impurities having a molecular weight of 5,000 or less at amount of 2,000 ppm or less. Naito shows that low molecular anions could be removed to as low as 125 ppm; therefore, showing impurities can be removed to be below 2,000 ppm. The motivation would be to remove the low molecular weight materials will enhance the emission efficiency and life of the EL device.

41. Regarding claim 10, Naito discloses that the hole transport material (paragraphs [0010] and [0100], PEDOT.PSS) (Naito discloses the material as a hole injection layer, but the layer transport holes from the anode into the emission layer) can be used as the major component to make a hole transport layer in and EL device (paragraphs [0010] and [0109]). Naito teaches the material used for the layer is purified using ultrafiltration with a membrane filter with a molecular weight cutoff between 8,000-25,000 to remove low molecular weight donor molecule ((poly(3,4-ethylenedioxythiophene) (paragraph [0033], which is a neutral impurity)) (paragraph [0081]) (This means molecular weights smaller than these value will be removed from the polymer during ultrafiltration). This means impurities having a molecular weight of 5,000 or less will be removed during the purification process.

42. Naito does not teach the amount of nonionic impurities contained with respect to the number of styrene units.

43. Naito does teach that low molecular weight materials need to be removed from the material to prevent low molecular weight materials from acting as a trapping agent or quencher when used as a layer in an EL device (paragraph [0006]). Naito teaches that anions can be removed to a value of 125 ppm in the layer (paragraph [0104]), which is a value lower than 6 impurities units per 1,000 styrene units. Naito teaches removing the low molecular weight materials will enhance the emission efficiency and life of the EL device (paragraph [0006]).

44. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the hole transport layer, of Naito, wherein in the hole

transport layer contains an amount of nonionic impurities to be 6 with respect to 1,000 styrene units. The motivation would be to remove the low molecular weight materials will enhance the emission efficiency and life of the EL device.

45. Regarding claim 11, Naito does not disclose the use of NMR to measure the number of nonionic impurities to styrene, but since the modified hole transport material reads on claim 5, it does not make the characterization technique used to measure the amount of the impurity because the ratio is an expected property of the purified material.

46. Regarding claims 12 and 29, Naito discloses that the hole transport material (paragraphs [0010] and [0100], PEDOT.PSS) can be used as the major component to make a hole transport layer in and EL device (paragraphs [0010] and [0109]).

47. Regarding claim 13, Naito discloses that the hole transport material (paragraphs [0010] and [0100], PEDOT.PSS) can be used as the major component to make a hole transport layer in and EL device (paragraphs [0010] and [0109]).

48. Regarding claims 16 and 17, Naito discloses a hole transport material (paragraphs [0010] and [0100], PEDOT.PSS) having the function of transporting holes in an organic EL device (paragraph [0010]) (Naito discloses the material as a hole injection layer, but the layer transport holes from the anode into the emission layer), wherein the material is dissolved in a solvent to make a 0.4 - 2.8 wt% solution (paragraph [0084]) and is purified using ultrafiltration with a membrane filter with a molecular weight cutoff between 8,000-25,000 to remove low molecular weight donor molecule ((poly(3,4-ethylenedioxythiophene) (paragraph [0033], which is a neutral impurity)) and ionic molecules (this includes both anions and cations) (paragraph

[0081]) (This means molecular weights smaller than these value will be removed from the polymer during ultrafiltration). This means impurities having a molecular weight of 5,000 or less will be removed during the purification process. Naito teaches the liquid contains anionic impurities at an amount of 2.5 ppm (paragraph [0104], Table 1 C1, 1.0 ppm when the concentration is 0.8 wt% equal 2.5 ppm in a 2.0 wt% concentrated solution).

49. Naito does not teach the amount of nonionic and cationic impurities present in the material or the total amount of impurities present.

50. Naito does teach that low molecular weight materials, including nonionic, cationic and anionic, need to be removed from the material to prevent low molecular weight materials from acting as a trapping agent or quencher when used as a layer in an EL device (paragraphs [0006] and [0081]). Naito teaches that anions can be removed to a value of 2.5 ppm for a 2.0 wt% solution of the material (paragraph [0104], Table 1 C1, 1.0 ppm when the concentration is 0.8 wt% equal 2.5 ppm in a 2.0 wt% concentrated solution), Naito teaches removing the low molecular weight materials will enhance the emission efficiency and life of the EL device (paragraph [0006]).

51. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the hole transport material, of Naito, wherein in the hole transport material when dissolved to make a 2.0 wt% solution, the solution contains nonionic, cationic, and anionic impurities having a molecular weight of 5,000 or less at amount of 40 ppm or less, 30 ppm or less, and 30 ppm or less respectively and wherein the total amount of impurities is 90 ppm or less. Naito shows that low molecular

anions could be removed to as low as 2.5 ppm; therefore, showing impurities can be removed to be below 40 ppm and 30 ppm. The motivation would be to remove the low molecular weight materials will enhance the emission efficiency and life of the EL device.

52. Regarding claim 18, Naito discloses the anionic impurities to include a sulfate ion (paragraph [0104], Table 1 1C).

53. Regarding claims 19 and 20, Naito discloses Baytron P VP CH8000 (paragraph [0100]) as the hole transport material, which inherently has Na, a group 1a metal as an impurities (see Baytron P VP CH8000 information).

54. Regarding claims 21 and 22, Naito discloses that low molecular weight donor molecular, poly(3,4-ethylenedioxythiophene (paragraph [0033]), which is a neutral heterocyclic aromatic compound is a impurity that needs to be removed (paragraph [0081]).

55. Regarding claim 23, Nation discloses the use of Baytron P VP CH8000 (paragraph [0100]) as the hole transport material, which inherently has a volume resistivity of  $1 \times 10^5$  to  $3 \times 10^5 \Omega\text{-cm}$  (see Clevios P VP CH8000 information, under resivity, Baytron P VP CH8000 now goes by Clevios P VP CH8000).

56. Regarding claims 24 and 25, Naito discloses the same hole transporting material as the applicant's hole transport material a poly(thiophene/styrenesulfonate)-based compound (PEDOT.PSS, paragraph [0100]) as the major component of the layer(paragraph [0105]).

57. Regarding claim 26, Naito discloses the use of Baytron P VP CH8000 (paragraph [0100]) a poly(thiophene/styrenesulfonate)-based compound hole transport material and the material inherently has a thiophene to styrenesulfonate ratio of 1:20 (see Clevios P VP CH8000 information, under PEDT:PSS ratio, Baytron P VP CH8000 now goes by Clevios P VP CH8000).

58. Regarding claims 27 and 28, Naito discloses the hole transport material (paragraphs [0010] and [0100], PEDOT.PSS) is used as the major component to make a hole transport layer (Naito discloses the material as a hole injection layer, but the layer transport holes from the anode into the emission layer) in and EL device (paragraphs [0010] and [0109]). Naito teaches the material used for the layer is purified using ultrafiltration with a membrane filter with a molecular weight cutoff between 8,000-25,000 to remove low molecular weight donor molecule ((poly(3,4-ethylenedioxythiophene) (paragraph [0033], which is a neutral impurity)) and ionic molecules (this includes both anions and cations) (paragraph [0081]) (This means molecular weights smaller than these value will be removed from the polymer during ultrafiltration). This means impurities having a molecular weight of 5,000 or less will be removed during the purification process. Naito teaches the layer contains anionic impurities at an amount of 125 ppm (paragraph [0104]).

59. Naito does not teach the amount of nonionic, cationic, and anionic impurities present in the layer or the total amount of impurities in the layer.

60. Naito does teach that low molecular weight materials need to be removed from the material to prevent to low molecular weight materials from acting as a trapping

agent or quencher when used as a layer in an EL device (paragraph [0006]). Naito teaches that anions can be removed to a value of 125 ppm in the layer (paragraph [0104]). Naito teaches removing the low molecular weight materials will enhance the emission efficiency and life of the EL device (paragraph [0006]).

61. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the hole transport layer, of Naito, wherein in the hole transport layer contains nonionic, cationic, and anionic impurities having a molecular weight of 5,000 or less at amount of 2,000 ppm or less, 1,500 ppm or less, and 1,500 ppm or less respectively and the total amount of impurities is 4,500 ppm or less. Naito shows that low molecular anions could be removed to as low as 125 ppm; therefore, showing impurities can be removed to be below 2,000 ppm or 1,500 ppm. The motivation would be to remove the low molecular weight materials will enhance the emission efficiency and life of the EL device.

62. Regarding claim 30, Naito discloses that the hole transport material (paragraphs [0010] and [0100], PEDOT:PSS) can be used as the major component to make a hole transport layer in an EL device (paragraphs [0010] and [0109]).

63. Claims 8, 16, 23-28, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Azuma et al. (WO 00/41443) where Higashi et al. (US 2004/0007971) (hereafter "Higashi") is used as the US equivalent, as applied to claims 1, 2, 4, 9, 12, 13, and 29 above, and further in view of Enomoto et al (KR 2003/078731), where Naito et al. (US 2004/0018386) (hereafter "Naito") is a patent family member was will be used as the English translation.

64. Regarding claims 8 and 23-26, Higashi does not teach a hole transport material, wherein the volume resistivity of the hole transport material is  $10 \Omega\text{-cm}$ .

65. Naito teaches the use discloses the use of Baytron P VP CH8000 (paragraph [0100]), a poly(thiophene/styrenesulfonate)-based compound, as the hole transport material, which inherently has a volume resistivity of  $1 \times 10^5$  to  $3 \times 10^5 \Omega\text{-cm}$  and a ratio of thiophene to styrenesulfonate of 1:20 (see Clevios P VP CH8000 information Baytron P VP CH8000 now goes by Clevios P VP CH8000) to provide a hole transport material that is thermally and chemically stable, can from thin uniform films and has excellent light transmittance (paragraph [0034]).

66. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the hole transporting material of Higashi to contain Baytron P VP CH8000, a poly(thiophene/styrenesulfonate)-based compound, as the major component. The motivation would have been to provide a hole transport material that is thermally and chemically stable, can from thin uniform films and has excellent light transmittance.

67. Regarding claim 16, 27, 28, and 30, Higashi teaches a hole transport material (NPD, paragraph [0146]) to be used as a layer in the an EL device (paragraph [0169]), wherein the material when dissolved in a liquid to have a concentration of 2.0 wt% has nonionic impurities (paragraph [0148] discloses the nonionic impurities to be 1-iodonaphthalene, approximate molecular weight 254, N-(naphthyl-1-yl)-N-N'-diphenyl-4,4'-benzidine, approximate molecular weight 262, and amine oxides, all amine oxides produced from the reaction would have a molecular weight less than 5,000 since all the

amines in the reaction are much less than 5,000 molecular weight and adding oxygen to any of the amines will not make the molecular weight exceed 5,000), having a molecular weight of 5,000 or less at an amount of the nonionic impurities of 20 ppm or less and when present in the layer the amount of nonionic impurities is 1000 ppm or less (paragraph [0149]) (Although Higashi does not implicitly teach a dissolved material, Higashi does disclose a material having nonionic impurities of 5,000 ppm or less at an amount of 1,000 ppm or less and if this material is dissolved at a concentration of 2.0 wt% the amount of nonionic impurities in the solution would be 20 ppm or less).

68. Higashi does not teach the amount of cationic and anionic impurities present in the material.

69. Naito teaches that ionic impurities, cationic and anionic, should be removed from the hole transport layer (paragraph [0006]) and showed that the amount of sulfate ions impurities after purification are 125 ppm in the material (which is 2.5 ppm in a 2.0 wt% concentrated solution), which is used for the layer (paragraph [0104]). Naito teaches that the ionic impurities can be removed using ion exchange and ultrafiltration (paragraph [0081]). Naito teaches the ionic impurities should be removed to prevent quenching of the luminescent material and deterioration of the display characteristics of the EL device (paragraph [0006]).

70. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the hole transporting material, of Higashi, to limit the amount of cationic and anion impurities having a molecular weight of 5,000 or less to 30 ppm or less for both when in a 2.0 wt% concentrated solution or 1,500 ppm or less when it is a

hole transport layer. Although not directly taught by Higashi or Naito it would be obvious to one of ordinary skill in the art to make the ionic impurities as low as possible and Naito showed that ionic impurities could be as low as 125 ppm when the hole transport material is used in a layer. The motivation would have been to prevent quenching of the luminescent material and deterioration of the display characteristics of the EL device.

### ***Conclusion***

71. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew K. Bohaty whose telephone number is (571)270-1148. The examiner can normally be reached on Monday through Thursday 7:30 am to 5:00 pm EST and every other Friday from 7:30 am to 4 pm EST.
72. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael LaVilla can be reached on (571)272-1539. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

73. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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